

Description

The 9FGV0631C is a member of IDT's SOC-Friendly 1.8V very low-power PCIe clock family. The device has 6 output enables for clock management, 2 different spread spectrum levels in addition to spread off, and 2 selectable SMBus addresses.

Typical Applications

PCIe Gen1-4 clock generation for Riser Cards, Storage, Networking, JBOD, Communications, Access Points

Output Features

- 6 100MHz Low-Power (LP) HCSL DIF pairs
- 1 1.8V LVCMOS REF output w/Wake-On-LAN (WOL) support

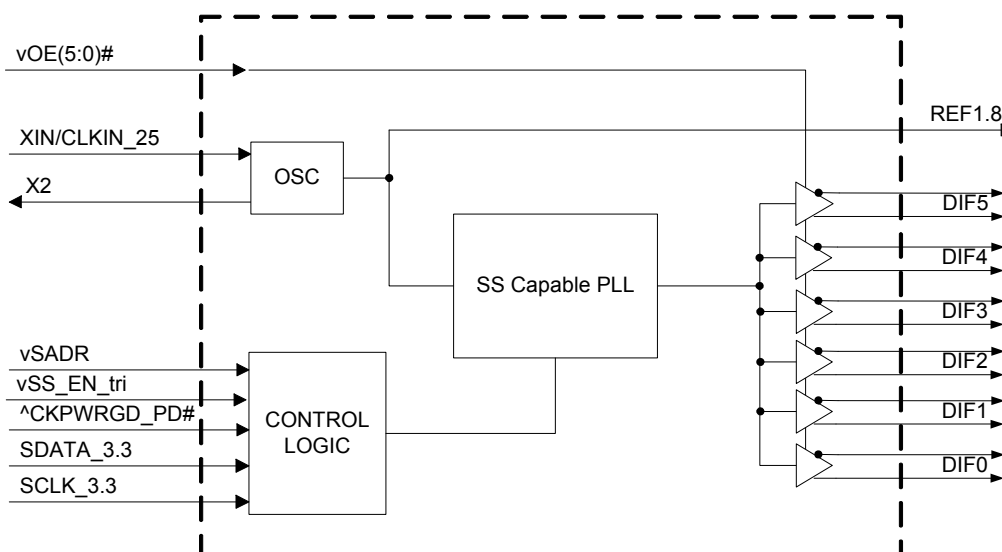
Key Specifications

- DIF cycle-to-cycle jitter <50ps
- DIF output-to-output skew <50ps
- DIF phase jitter is PCIe Gen1-2-3-4 compliant
- REF phase jitter is <1.5ps RMS

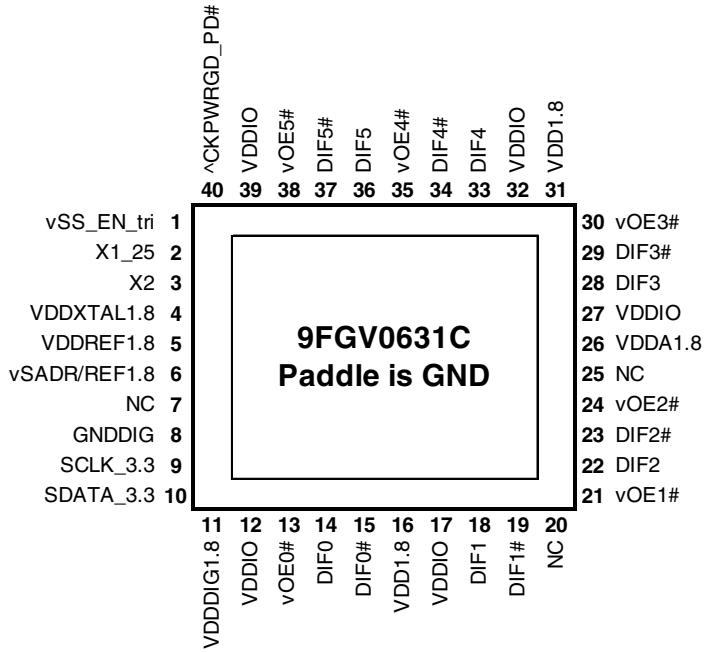
Features

- LP-HCSL outputs; save 12 resistors compared to standard PCIe devices
- 54mW typical power consumption; reduced thermal concerns
- Outputs can optionally be supplied from any voltage between 1.05V and 1.8V; maximum power savings
- OE# pins; support DIF power management
- Programmable slew rate for each output; allows tuning for various line lengths
- Programmable output amplitude; allows tuning for various application environments
- DIF outputs blocked until PLL is locked; clean system start-up
- Selectable 0%, -0.25% or -0.5% spread on DIF outputs; reduces EMI
- External 25MHz crystal; supports tight ppm with 0 ppm synthesis error
- Configuration can be accomplished with strapping pins; SMBus interface not required for device control
- 3.3V tolerant SMBus interface works with legacy controllers
- Selectable SMBus addresses; multiple devices can easily share an SMBus segment
- Space saving 5 x 5 mm 40-VFQFPN; minimal board space

Block Diagram



Pin Configuration



40-VFQFPN, 5 x 5 mm, 0.4mm pitch

- v prefix indicates internal 120kOhm pull-down resistor
- ^ prefix indicates internal 120kOhm pull-up resistor

SMBus Address Selection Table

| | SADR | Address | + Read/Write Bit |
|---|------|---------|------------------|
| State of SADR on first application of CKPWRGD_PD# | 0 | 1101000 | x |
| | 1 | 1101010 | x |

Power Management Table

| CKPWRGD_PD# | SMBus OE bit | DIFx | | | REF |
|-------------|--------------|------|----------|-----------|-------------------|
| | | OEx# | True O/P | Comp. O/P | |
| 0 | X | X | Low | Low | Hi-Z ¹ |
| 1 | 1 | 0 | Running | Running | Running |
| 1 | 0 | 1 | Low | Low | Low |

1. REF is Hi-Z until the 1st assertion of CKPWRGD_PD# high. After this, when CKPWRGD_PD# is low, REF is Low.

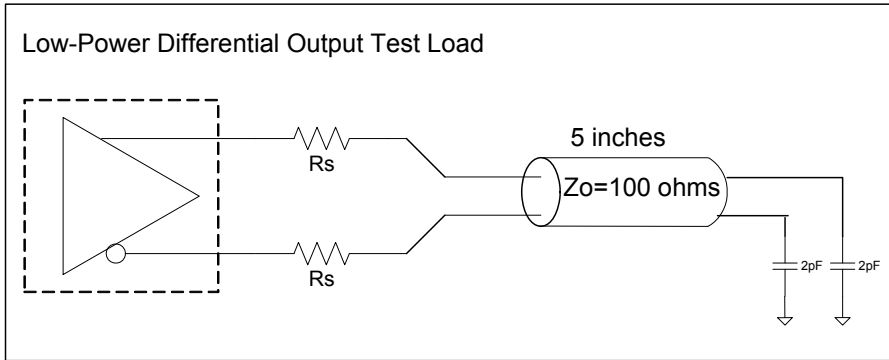
Power Connections

| Pin Number | | GND | Description |
|------------|----------------|-----|-----------------------|
| VDD | VDDIO | | |
| 4 | | 41 | XTAL OSC |
| 5 | | 41 | REF Power |
| 11 | | 8 | Digital (dirty) Power |
| | 12,17,27,32,39 | 41 | DIF outputs |
| 26 | | 41 | PLL Analog |

Pin Descriptions

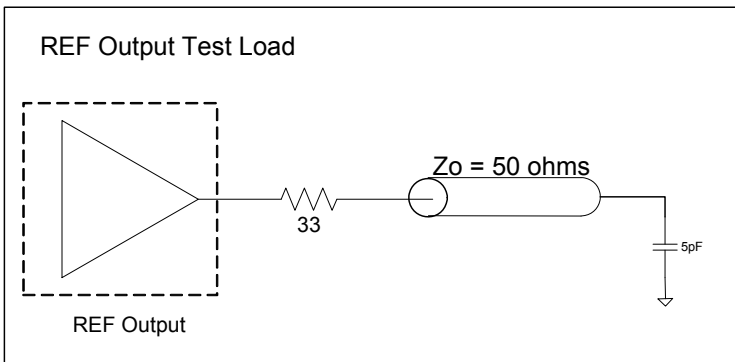
| PIN # | PIN NAME | PIN TYPE | DESCRIPTION |
|-------|--------------|----------------|---|
| 1 | vSS_EN_tri | LATCHED IN | Latched select input to select spread spectrum amount at initial power up : 1 = -0.5% spread, M = -0.25%, 0 = Spread Off |
| 2 | X1_25 | IN | Crystal input, Nominally 25.00MHz. |
| 3 | X2 | OUT | Crystal output. |
| 4 | VDDXTAL1.8 | PWR | Power supply for XTAL, nominal 1.8V |
| 5 | VDDREF1.8 | PWR | VDD for REF output. nominal 1.8V. |
| 6 | vSADR/REF1.8 | LATCHED I/O | Latch to select SMBus Address/1.8V LVCMOS copy of X1/REFIN pin |
| 7 | NC | N/A | No Connection. |
| 8 | GNDDIG | GND | Ground pin for digital circuitry |
| 9 | SCLK_3.3 | IN | Clock pin of SMBus circuitry, 3.3V tolerant. |
| 10 | SDATA_3.3 | I/O | Data pin for SMBus circuitry, 3.3V tolerant. |
| 11 | VDDDIG1.8 | PWR | 1.8V digital power (dirty power) |
| 12 | VDDIO | PWR | Power supply for differential outputs |
| 13 | voE0# | IN | Active low input for enabling DIF pair 0. This pin has an internal pull-down. 1 =disable outputs, 0 = enable outputs |
| 14 | DIF0 | OUT | Differential true clock output |
| 15 | DIF0# | OUT | Differential Complementary clock output |
| 16 | VDD1.8 | PWR | Power supply, nominal 1.8V |
| 17 | VDDIO | PWR | Power supply for differential outputs |
| 18 | DIF1 | OUT | Differential true clock output |
| 19 | DIF1# | OUT | Differential Complementary clock output |
| 20 | NC | N/A | No Connection. |
| 21 | voE1# | IN | Active low input for enabling DIF pair 1. This pin has an internal pull-down. 1 =disable outputs, 0 = enable outputs |
| 22 | DIF2 | OUT | Differential true clock output |
| 23 | DIF2# | OUT | Differential Complementary clock output |
| 24 | voE2# | IN | Active low input for enabling DIF pair 2. This pin has an internal pull-down. 1 =disable outputs, 0 = enable outputs |
| 25 | NC | N/A | No Connection. |
| 26 | VDDA1.8 | PWR | 1.8V power for the PLL core. |
| 27 | VDDIO | PWR | Power supply for differential outputs |
| 28 | DIF3 | OUT | Differential true clock output |
| 29 | DIF3# | OUT | Differential Complementary clock output |
| 30 | voE3# | IN | Active low input for enabling DIF pair 3. This pin has an internal pull-down. 1 =disable outputs, 0 = enable outputs |
| 31 | VDD1.8 | PWR | Power supply, nominal 1.8V |
| 32 | VDDIO | PWR | Power supply for differential outputs |
| 33 | DIF4 | OUT | Differential true clock output |
| 34 | DIF4# | OUT | Differential Complementary clock output |
| 35 | voE4# | IN | Active low input for enabling DIF pair 4. This pin has an internal pull-down. 1 =disable outputs, 0 = enable outputs |
| 36 | DIF5 | OUT | Differential true clock output |
| 37 | DIF5# | OUT | Differential Complementary clock output |
| 38 | voE5# | IN | Active low input for enabling DIF pair 5. This pin has an internal pull-down. 1 =disable outputs, 0 = enable outputs |
| 39 | VDDIO | PWR | Power supply for differential outputs |
| 40 | ^CKPWRGD_PD# | IN | Input notifies device to sample latched inputs and start up on first high assertion. Low enters Power Down Mode, subsequent high assertions exit Power Down Mode. This pin has internal pull-up resistor. |
| 41 | ePAD | GND | Connect paddle to ground. |

Test Loads

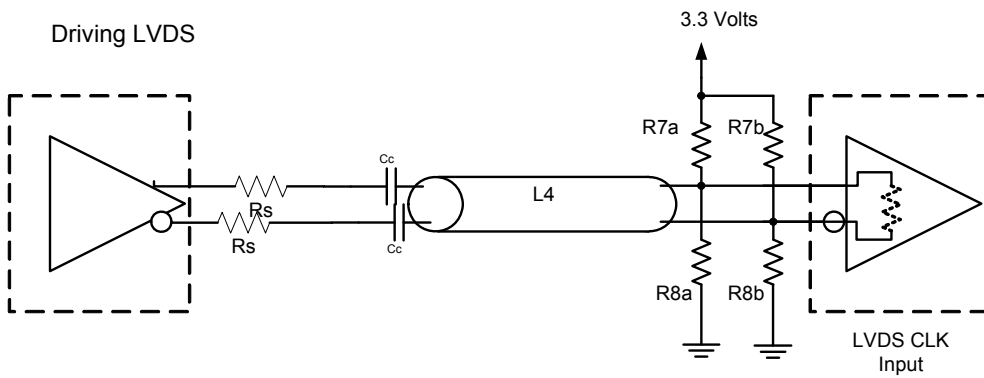


Alternate Differential Output Terminations

| Rs | Zo | Units |
|----|-----|-------|
| 33 | 100 | Ohms |
| 27 | 85 | |



Driving LVDS



Driving LVDS inputs

| Component | Value | | Note |
|-----------|--------------------------|------------------------------------|------|
| | Receiver has termination | Receiver does not have termination | |
| R7a, R7b | 10K ohm | 140 ohm | |
| R8a, R8b | 5.6K ohm | 75 ohm | |
| Cc | 0.1 uF | 0.1 uF | |
| Vcm | 1.2 volts | 1.2 volts | |

Absolute Maximum Ratings

Stresses above the ratings listed below can cause permanent damage to the 9FGV0631C. These ratings, which are standard values for IDT commercially rated parts, are stress ratings only. Functional operation of the device at these or any other conditions above those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods can affect product reliability. Electrical parameters are guaranteed only over the recommended operating temperature range.

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS | NOTES |
|---------------------------|--------------------|---------------------------|------|-----|-----------------------|-------|-------|
| Supply Voltage | VDDxx | Applies to all VDD pins | -0.5 | | 2.5 | V | 1,2 |
| Input Voltage | V _{IN} | | -0.5 | | V _{DD} +0.5V | V | 1, 3 |
| Input High Voltage, SMBus | V _{IHSMB} | SMBus clock and data pins | | | 3.6V | V | 1 |
| Storage Temperature | T _s | | -65 | | 150 | °C | 1 |
| Junction Temperature | T _j | | | | 125 | °C | 1 |
| Input ESD protection | ESD prot | Human Body Model | 2000 | | | V | 1 |

¹Guaranteed by design and characterization, not 100% tested in production.

²Operation under these conditions is neither implied nor guaranteed.

³Not to exceed 2.5V.

Electrical Characteristics—Current Consumption

T_A = T_{AMB}; Supply Voltages per normal operation conditions, See Test Loads for Loading Conditions

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS | NOTES |
|---|---------------------|--|-----|--------|-----|-------|-------|
| Operating Supply Current | I _{DDAOP} | VDDA, All outputs active @100MHz | | 6.1 | 9 | mA | |
| | I _{DDOP} | All VDD, except VDDA and VDDIO, All outputs active @100MHz | | 10.5 | 15 | mA | |
| | I _{DDIOOP} | VDDIO, All outputs active @100MHz | | 22 | 30 | mA | |
| Wake-on-LAN Current (CKPWRGD_PD# = '0' Byte 3, bit 5 = '1') | I _{DDAPD} | VDDA, DIF outputs off, REF output running | | 0.4 | 1 | mA | 2 |
| | I _{DDPD} | All VDD, except VDDA and VDDIO, DIF outputs off, REF output running | | 5.5 | 8 | mA | 2 |
| | I _{DDIOPD} | VDDIO, DIF outputs off, REF output running | | 0.04 | 0.1 | mA | 2 |
| Powerdown Current (CKPWRGD_PD# = '0' Byte 3, bit 5 = '0') | I _{DDAPD} | VDDA, all outputs off | | 0.4 | 1 | mA | |
| | I _{DDPD} | All VDD, except VDDA and VDDIO, all outputs off | | 0.6 | 1 | mA | |
| | I _{DDIOPD} | VDDIO, all outputs off | | 0.0003 | 0.1 | mA | |

¹Guaranteed by design and characterization, not 100% tested in production.

²This is the current required to have the REF output running in Wake-on-LAN mode (Byte 3, bit 5 = 1)

Electrical Characteristics—DIF Output Duty Cycle, Jitter, and Skew Characteristics

T_A = T_{AMB}; Supply Voltages per normal operation conditions, See Test Loads for Loading Conditions

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS | NOTES |
|------------------------|----------------------|------------------------------------|-----|------|-----|-------|-------|
| Duty Cycle | t _{DC} | Measured differentially, PLL Mode | 45 | 49.9 | 55 | % | 1,2 |
| Skew, Output to Output | t _{sk3} | Averaging on, V _T = 50% | | 37 | 50 | ps | 1,2 |
| Jitter, Cycle to cycle | t _{jcy-cyc} | | | 12 | 50 | ps | 1,2 |

¹Guaranteed by design and characterization, not 100% tested in production.

²Measured from differential waveform

Electrical Characteristics–Input/Supply/Common Output Parameters–Normal Operating Conditions

TA = T_{AMB}; Supply Voltages per normal operation conditions, See Test Loads for Loading Conditions

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS | NOTES |
|-------------------------------|---------------------|---|-----------------------|---------------------|-----------------------|--------|-------|
| Supply Voltage | VDDxx | Supply voltage for core, analog and single-ended LVCMOS outputs | 1.7 | 1.8 | 1.9 | V | |
| Output Supply Voltage | VDDIO | Supply voltage for differential Low Power Outputs | 0.9975 | 1.05-1.8 | 1.9 | V | |
| Ambient Operating Temperature | T _{AMB} | Commercial range | 0 | 25 | 70 | °C | |
| | | Industrial range | -40 | 25 | 85 | °C | |
| Input High Voltage | V _{IH} | Single-ended inputs, except SMBus | 0.75 V _{DD} | | V _{DD} + 0.3 | V | |
| Input Mid Voltage | V _{IM} | Single-ended tri-level inputs ('_tri' suffix) | 0.4 V _{DD} | 0.5 V _{DD} | 0.6 V _{DD} | V | |
| Input Low Voltage | V _{IL} | Single-ended inputs, except SMBus | -0.3 | | 0.25 V _{DD} | V | |
| Output High Voltage | V _{IH} | Single-ended outputs, except SMBus. I _{OH} = -2mA | V _{DD} -0.45 | | | V | |
| Output Low Voltage | V _{IL} | Single-ended outputs, except SMBus. I _{OL} = -2mA | | | 0.45 | V | |
| Input Current | I _{IN} | Single-ended inputs, V _{IN} = GND, V _{IN} = VDD | -5 | | 5 | uA | |
| | I _{INP} | Single-ended inputs V _{IN} = 0 V; Inputs with internal pull-up resistors V _{IN} = VDD; Inputs with internal pull-down resistors | -200 | | 200 | uA | |
| Input Frequency | F _{in} | XTAL, or X1 input | 23 | 25 | 27 | MHz | |
| Pin Inductance | L _{pin} | | | | 7 | nH | 1 |
| Capacitance | C _{IN} | Logic Inputs, except DIF_IN | 1.5 | | 5 | pF | 1 |
| | C _{OUT} | Output pin capacitance | | | 6 | pF | 1 |
| Clk Stabilization | T _{STAB} | From V _{DD} Power-Up and after input clock stabilization or de-assertion of PD# to 1st clock | | 0.6 | 1.8 | ms | 1,2 |
| SS Modulation Frequency | f _{MOD} | Allowable Frequency (Triangular Modulation) | 30 | 31.6 | 33 | kHz | 1 |
| OE# Latency | t _{LATOE#} | DIF start after OE# assertion DIF stop after OE# deassertion | 1 | 3 | 3 | clocks | 1,3 |
| Tdrive_PD# | t _{DRVDPD} | DIF output enable after PD# de-assertion | | 20 | 300 | us | 1,3 |
| Tfall | t _F | Fall time of single-ended control inputs | | | 5 | ns | 2 |
| Trise | t _R | Rise time of single-ended control inputs | | | 5 | ns | 2 |
| SMBus Input Low Voltage | V _{ILSMB} | V _{DD} SMB = 3.3V, see note 4 for V _{DD} SMB < 3.3V | | | 0.6 | V | |
| SMBus Input High Voltage | V _{IHSMB} | V _{DD} SMB = 3.3V, see note 5 for V _{DD} SMB < 3.3V | 2.1 | | 3.6 | V | 4 |
| SMBus Output Low Voltage | V _{OLSMB} | @ I _{PULLUP} | | | 0.4 | V | |
| SMBus Sink Current | I _{PULLUP} | @ V _{OL} | 4 | | | mA | |
| Nominal Bus Voltage | V _{DD} SMB | | 1.7 | | 3.6 | V | |
| SCLK/SDATA Rise Time | t _{RSMB} | (Max V _{IL} - 0.15) to (Min V _{IH} + 0.15) | | | 1000 | ns | 1 |
| SCLK/SDATA Fall Time | t _{FSMB} | (Min V _{IH} + 0.15) to (Max V _{IL} - 0.15) | | | 300 | ns | 1 |
| SMBus Operating Frequency | f _{MAXSMB} | Maximum SMBus operating frequency | | | 400 | kHz | 1 |

¹ Guaranteed by design and characterization, not 100% tested in production.

² Control input must be monotonic from 20% to 80% of input swing.

³ Time from deassertion until outputs are >200 mV

⁴ For V_{DD}SMB < 3.3V, V_{IHSMB} >= 0.65xV_{DD}SMB

Electrical Characteristics–DIF Low Power HCSL Outputs

TA = T_{AMB}; Supply Voltages per normal operation conditions, See Test Loads for Loading Conditions

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS | NOTES |
|------------------------|------------------------|---|------|------|------|-------|-------|
| Slew rate | Trf | Scope averaging on fast setting | 1.8 | 2.7 | 4.4 | V/ns | 1,2,3 |
| | | Scope averaging on slow setting | 1.4 | 2.1 | 3.4 | V/ns | 1,2,3 |
| Slew rate matching | ΔTrf | Slew rate matching, Scope averaging on | | 4 | 20 | % | 1,2,4 |
| Voltage High | V _{HIGH} | Statistical measurement on single-ended signal using oscilloscope math function. (Scope averaging on) | 660 | 793 | 850 | mV | 7 |
| Voltage Low | V _{LOW} | | -150 | 16 | 150 | | 7 |
| Max Voltage | V _{max} | Measurement on single ended signal using absolute value. (Scope averaging off) | | 831 | 1150 | mV | 7 |
| Min Voltage | V _{min} | | -300 | -95 | | | 7 |
| Vswing | Vswing | Scope averaging off | 300 | 1555 | | mV | 1,2,7 |
| Crossing Voltage (abs) | V _{cross_abs} | Scope averaging off | 250 | 429 | 550 | mV | 1,5,7 |
| Crossing Voltage (var) | Δ-V _{cross} | Scope averaging off | | 12 | 140 | mV | 1,6,7 |

¹Guaranteed by design and characterization, not 100% tested in production.

² Measured from differential waveform

³ Slew rate is measured through the Vswing voltage range centered around differential 0V. This results in a +/-150mV window around differential 0V.

⁴ Matching applies to rising edge rate for Clock and falling edge rate for Clock#. It is measured using a +/-75mV window centered on the average cross point where Clock rising meets Clock# falling. The median cross point is used to calculate the voltage thresholds the oscilloscope is to use for the edge rate calculations.

⁵ V_{cross} is defined as voltage where Clock = Clock# measured on a component test board and only applies to the differential rising edge (i.e. Clock rising and Clock# falling).

⁶ The total variation of all V_{cross} measurements in any particular system. Note that this is a subset of V_{cross_min}/max (V_{cross} absolute) allowed. The intent is to limit V_{cross} induced modulation by setting □-V_{cross} to be smaller than V_{cross} absolute.

⁷ At default SMBus amplitude settings.

Electrical Characteristics–Filtered Phase Jitter Parameters - PCIe Common Clocked (CC) Architectures

T_{AMB} = over the specified operating range. Supply Voltages per normal operation conditions, See Test Loads for Loading Conditions

| SYMBOL | PARAMETER | CONDITIONS | MIN | TYP | MAX | Specification Limit | UNITS | NOTES |
|---------------------------|------------------------|--|-----|------|------|---------------------|----------|---------|
| t _{jphPCIeG1-CC} | Phase Jitter, PLL Mode | PCIe Gen 1 | 21 | 25 | 35 | 86 | ps (p-p) | 1, 2, 3 |
| t _{jphPCIeG2-CC} | | PCIe Gen 2 Low Band 10kHz < f < 1.5MHz (PLL BW of 5-16MHz, 8-16MHz, CDR = 5MHz) | 0.9 | 0.9 | 1.1 | 3 | ps (rms) | 1, 2 |
| | | PCIe Gen 2 High Band 1.5MHz < f < Nyquist (50MHz) (PLL BW of 5-16MHz, 8-16MHz, CDR = 5MHz) | 1.5 | 1.6 | 1.9 | 3.1 | ps (rms) | 1, 2 |
| t _{jphPCIeG3-CC} | | PCIe Gen 3 (PLL BW of 2-4MHz, 2-5MHz, CDR = 10MHz) | 0.3 | 0.37 | 0.44 | 1 | ps (rms) | 1, 2 |
| t _{jphPCIeG4-CC} | | PCIe Gen 4 (PLL BW of 2-4MHz, 2-5MHz, CDR = 10MHz) | 0.3 | 0.37 | 0.44 | 0.5 | ps (rms) | 1, 2 |

Notes on PCIe Filtered Phase Jitter Table

¹ Applies to all differential outputs, guaranteed by design and characterization.

² Calculated from Intel-supplied Clock Jitter Tool, with spread on and off.

³ Sample size of at least 100K cycles. This figure extrapolates to 108ps pk-pk at 1M cycles for a BER of 1⁻¹².

Electrical Characteristics–REF

TA = T_{AMB}; Supply Voltages per normal operation conditions, See Test Loads for Loading Conditions

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS | Notes |
|------------------------|-----------------------|-----------------------------------|-----|--------|------|-------------|-------|
| Long Accuracy | ppm | see Tperiod min-max values | | 0 | | ppm | 1,2 |
| Clock period | T _{period} | 25 MHz output | | 40 | | ns | 2 |
| Rise/Fall Slew Rate | t _{rf1} | Byte 3 = 1F, 20% to 80% of VDDREF | 0.6 | 1 | 1.6 | V/ns | 1 |
| Rise/Fall Slew Rate | t _{rf1} | Byte 3 = 5F, 20% to 80% of VDDREF | 0.9 | 1.4 | 2.2 | V/ns | 1,3 |
| Rise/Fall Slew Rate | t _{rf1} | Byte 3 = 9F, 20% to 80% of VDDREF | 1.1 | 1.7 | 2.7 | V/ns | 1 |
| Rise/Fall Slew Rate | t _{rf1} | Byte 3 = DF, 20% to 80% of VDDREF | 1.1 | 1.8 | 2.9 | V/ns | 1 |
| Duty Cycle | d _{t1X} | V _T = VDD/2 V | 45 | 49.1 | 55 | % | 1,4 |
| Duty Cycle Distortion | d _{ted} | V _T = VDD/2 V | 0 | 2 | 4 | % | 1,5 |
| Jitter, cycle to cycle | t _{jcyc-cyc} | V _T = VDD/2 V | | 19.1 | 250 | ps | 1,4 |
| Noise floor | t _{dBc1k} | 1kHz offset | | -129.8 | -105 | dBc | 1,4 |
| Noise floor | t _{dBc10k} | 10kHz offset to Nyquist | | -143.6 | -115 | dBc | 1,4 |
| Jitter, phase | t _{jphREF} | 12kHz to 5MHz | | 0.63 | 1.5 | ps (rms) | 1,4 |

¹Guaranteed by design and characterization, not 100% tested in production.

²All Long Term Accuracy and Clock Period specifications are guaranteed assuming that REF is trimmed to 25.00 MHz

³Default SMBus Value

⁴When driven by a crystal.

⁵When driven by an external oscillator via the X1 pin, X2 should be floating.

Clock Periods–Differential Outputs with Spread Spectrum Disabled

| SSC OFF | Center Freq. MHz | Measurement Window | | | | | | | Units | Notes |
|---------|------------------|------------------------------|--------------------------------------|--------------------------------------|----------------------------|--------------------------------------|--------------------------------------|------------------------------|-------|-------|
| | | 1 Clock | 1us | 0.1s | 0.1s | 0.1s | 1us | 1 Clock | | |
| | | -c2c jitter AbsPer Min | -SSC Short-Term Average Min | - ppm Long-Term Average Min | 0 ppm Period Nominal | + ppm Long-Term Average Max | +SSC Short-Term Average Max | +c2c jitter AbsPer Max | | |
| DIF | 100.00 | 9.94900 | | 9.99900 | 10.00000 | 10.00100 | | 10.05100 | ns | 1,2 |

Clock Periods–Differential Outputs with Spread Spectrum Enabled

| SSC ON | Center Freq. MHz | Measurement Window | | | | | | | Units | Notes |
|--------|------------------|------------------------------|--------------------------------------|--------------------------------------|----------------------------|--------------------------------------|--------------------------------------|------------------------------|-------|-------|
| | | 1 Clock | 1us | 0.1s | 0.1s | 0.1s | 1us | 1 Clock | | |
| | | -c2c jitter AbsPer Min | -SSC Short-Term Average Min | - ppm Long-Term Average Min | 0 ppm Period Nominal | + ppm Long-Term Average Max | +SSC Short-Term Average Max | +c2c jitter AbsPer Max | | |
| DIF | 99.75 | 9.94906 | 9.99906 | 10.02406 | 10.02506 | 10.02607 | 10.05107 | 10.10107 | ns | 1,2 |

¹Guaranteed by design and characterization, not 100% tested in production.

²All Long Term Accuracy specifications are guaranteed with the assumption that the crystal input is tuned to exactly 14.31818MHz.

Clock Periods–Single-ended Outputs

| SSC OFF | Center Freq. MHz | Measurement Window | | | | | | | Units | Notes |
|---------|------------------|------------------------------|--------------------------------------|--------------------------------------|----------------------------|--------------------------------------|--------------------------------------|------------------------------|-------|-------|
| | | 1 Clock | 1us | 0.1s | 0.1s | 0.1s | 1us | 1 Clock | | |
| | | -c2c jitter AbsPer Min | -SSC Short-Term Average Min | - ppm Long-Term Average Min | 0 ppm Period Nominal | + ppm Long-Term Average Max | +SSC Short-Term Average Max | +c2c jitter AbsPer Max | | |
| REF | 25.000 | 39.79880 | | 39.99880 | 40.00000 | 40.00120 | | 40.20120 | ns | 1,2 |

General SMBus Serial Interface Information

How to Write

- Controller (host) sends a start bit
- Controller (host) sends the write address
- IDT clock will **acknowledge**
- Controller (host) sends the beginning byte location = N
- IDT clock will **acknowledge**
- Controller (host) sends the byte count = X
- IDT clock will **acknowledge**
- Controller (host) starts sending Byte **N through Byte N+X-1**
- IDT clock will **acknowledge** each byte **one at a time**
- Controller (host) sends a stop bit

| Index Block Write Operation | | | |
|-----------------------------|-----------|--------|----------------------|
| Controller (Host) | | | IDT (Slave/Receiver) |
| T | starT bit | | |
| Slave Address | | | |
| WR | WRite | | |
| Beginning Byte = N | | | ACK |
| | | | ACK |
| Data Byte Count = X | | | ACK |
| Beginning Byte N | | X Byte | ACK |
| O | | | O |
| O | | | O |
| O | | | O |
| Byte N + X - 1 | | | ACK |
| P | stoP bit | | |

Note: Read/Write address is latched on SADR pin.

How to Read

- Controller (host) will send a start bit
- Controller (host) sends the write address
- IDT clock will **acknowledge**
- Controller (host) sends the beginning byte location = N
- IDT clock will **acknowledge**
- Controller (host) will send a separate start bit
- Controller (host) sends the read address
- IDT clock will **acknowledge**
- IDT clock will send the data byte count = X
- IDT clock sends Byte **N+X-1**
- IDT clock sends **Byte 0 through Byte X (if X_(H) was written to Byte 8)**
- Controller (host) will need to acknowledge each byte
- Controller (host) will send a not acknowledge bit
- Controller (host) will send a stop bit

| Index Block Read Operation | | | |
|----------------------------|-----------------|--------|----------------------|
| Controller (Host) | | | IDT (Slave/Receiver) |
| T | starT bit | | |
| Slave Address | | | |
| WR | WRite | | |
| Beginning Byte = N | | | ACK |
| | | | ACK |
| RT | Repeat starT | | |
| Slave Address | | | |
| RD | ReaD | | |
| | | | ACK |
| ACK | | | |
| ACK | | X Byte | Beginning Byte N |
| O | | | O |
| O | | | O |
| O | | | O |
| | | | Data Byte Count=X |
| | | | Byte N + X - 1 |
| N | Not acknowledge | | |
| P | stoP bit | | |

SMBus Table: Output Enable Register ¹

| Byte 0 | Name | Control Function | Type | 0 | 1 | Default |
|--------|----------|------------------|------|---------|---------|---------|
| Bit 7 | DIF OE5 | Output Enable | RW | Low/Low | Enabled | 1 |
| Bit 6 | DIF OE4 | Output Enable | RW | Low/Low | Enabled | 1 |
| Bit 5 | Reserved | | | | | 1 |
| Bit 4 | DIF OE3 | Output Enable | RW | Low/Low | Enabled | 1 |
| Bit 3 | DIF OE2 | Output Enable | RW | Low/Low | Enabled | 1 |
| Bit 2 | DIF OE1 | Output Enable | RW | Low/Low | Enabled | 1 |
| Bit 1 | Reserved | | | | | 1 |
| Bit 0 | DIF OE0 | Output Enable | RW | Low/Low | Enabled | 1 |

1. A low on these bits will override the OE# pin and force the differential output Low/Low

SMBus Table: SS Readback and Control Register

| Byte 1 | Name | Control Function | Type | 0 | 1 | Default |
|--------|--------------|-----------------------------|-----------------|--|--------------------------------------|---------|
| Bit 7 | SSENRB1 | SS Enable Readback Bit1 | R | 00' for SS_EN_tri = 0, '01' for SS_EN_tri = 'M', '11 for SS_EN_tri = '1' | | Latch |
| Bit 6 | SSENRB1 | SS Enable Readback Bit0 | R | | | Latch |
| Bit 5 | SSEN_SWCNTRL | Enable SW control of SS | RW | Values in B1[7:6] control SS amount | Values in B1[4:3] control SS amount. | 0 |
| Bit 4 | SSENSW1 | SS Enable Software Ctl Bit1 | RW ¹ | 00' = SS Off, '01' = -0.25% SS, '10' = Reserved, '11' = -0.5% SS | | 0 |
| Bit 3 | SSENSW0 | SS Enable Software Ctl Bit0 | RW ¹ | | | 0 |
| Bit 2 | Reserved | | | | | 1 |
| Bit 1 | AMPLITUDE 1 | Controls Output Amplitude | RW | 00 = 0.6V | 01 = 0.7V | 1 |
| Bit 0 | AMPLITUDE 0 | | RW | 10 = 0.8V | 11 = 0.9V | 0 |

1. B1[5] must be set to a 1 for these bits to have any effect on the part.

SMBus Table: DIF Slew Rate Control Register

| Byte 2 | Name | Control Function | Type | 0 | 1 | Default |
|--------|------------------|--------------------------|------|--------------|--------------|---------|
| Bit 7 | SLEWRATESEL DIF5 | Adjust Slew Rate of DIF5 | RW | Slow Setting | Fast Setting | 1 |
| Bit 6 | SLEWRATESEL DIF4 | Adjust Slew Rate of DIF4 | RW | Slow Setting | Fast Setting | 1 |
| Bit 5 | Reserved | | | | | 1 |
| Bit 4 | SLEWRATESEL DIF3 | Adjust Slew Rate of DIF3 | RW | Slow Setting | Fast Setting | 1 |
| Bit 3 | SLEWRATESEL DIF2 | Adjust Slew Rate of DIF2 | RW | Slow Setting | Fast Setting | 1 |
| Bit 2 | SLEWRATESEL DIF1 | Adjust Slew Rate of DIF1 | RW | Slow Setting | Fast Setting | 1 |
| Bit 1 | Reserved | | | | | 1 |
| Bit 0 | SLEWRATESEL DIF0 | Adjust Slew Rate of DIF0 | RW | Slow Setting | Fast Setting | 1 |

SMBus Table: Nominal Vhigh Amplitude Control/ REF Control Register

| Byte 3 | Name | Control Function | Type | 0 | 1 | Default |
|--------|-------------------------|----------------------------|------|--------------------------------|------------------------|---------|
| Bit 7 | REF | Slew Rate Control | RW | 00 = Slowest | 01 = Slow | 0 |
| Bit 6 | | | RW | 10 = Fast | 11 = Faster | 1 |
| Bit 5 | REF Power Down Function | Wake-on-Lan Enable for REF | RW | REF does not run in Power Down | REF runs in Power Down | 0 |
| Bit 4 | REF OE | REF Output Enable | RW | Low | Enabled | 1 |
| Bit 3 | Reserved | | | | | 1 |
| Bit 2 | Reserved | | | | | 1 |
| Bit 1 | Reserved | | | | | 1 |
| Bit 0 | Reserved | | | | | 1 |

Byte 4 is Reserved

SMBus Table: Revision and Vendor ID Register

| Byte 5 | Name | Control Function | Type | 0 | 1 | Default |
|--------|------|------------------|------|--------------|---|---------|
| Bit 7 | RID3 | Revision ID | R | C rev = 0001 | | 0 |
| Bit 6 | RID2 | | R | | | 0 |
| Bit 5 | RID1 | | R | | | 0 |
| Bit 4 | RID0 | | R | | | 1 |
| Bit 3 | VID3 | VENDOR ID | R | 0001 = IDT | | 0 |
| Bit 2 | VID2 | | R | | | 0 |
| Bit 1 | VID1 | | R | | | 0 |
| Bit 0 | VID0 | | R | | | 1 |

SMBus Table: Device Type/Device ID

| Byte 6 | Name | Control Function | Type | 0 | 1 | Default |
|--------|--------------|------------------|------|--|---|---------|
| Bit 7 | Device Type1 | Device Type | R | 00 = FGx, 01 = DBx ZDB/FOB, 10 = DMx, 11= DBx FOB | | 0 |
| Bit 6 | Device Type0 | | R | | | 0 |
| Bit 5 | Device ID5 | Device ID | R | 000110 binary or 06 hex | | 0 |
| Bit 4 | Device ID4 | | R | | | 0 |
| Bit 3 | Device ID3 | | R | | | 0 |
| Bit 2 | Device ID2 | | R | | | 1 |
| Bit 1 | Device ID1 | | R | | | 1 |
| Bit 0 | Device ID0 | | R | | | 0 |

SMBus Table: Byte Count Register

| Byte 7 | Name | Control Function | Type | 0 | 1 | Default |
|--------|------|------------------------|------|---|---|---------|
| Bit 7 | | Reserved | | | | 0 |
| Bit 6 | | Reserved | | | | 0 |
| Bit 5 | | Reserved | | | | 0 |
| Bit 4 | BC4 | Byte Count Programming | RW | Writing to this register will configure how many bytes will be read back, default is = 8 bytes. | | 0 |
| Bit 3 | BC3 | | RW | | | 1 |
| Bit 2 | BC2 | | RW | | | 0 |
| Bit 1 | BC1 | | RW | | | 0 |
| Bit 0 | BC0 | | RW | | | 0 |

Recommended Crystal Characteristics (3225 package)

| PARAMETER | VALUE | UNITS | NOTES |
|--|-------------|---------|-------|
| Frequency | 25 | MHz | 1 |
| Resonance Mode | Fundamental | - | 1 |
| Frequency Tolerance @ 25°C | ±20 | PPM Max | 1 |
| Frequency Stability, ref @ 25°C Over Operating Temperature Range | ±20 | PPM Max | 1 |
| Temperature Range (commercial) | 0~70 | °C | 1 |
| Temperature Range (industrial) | -40~85 | °C | 2 |
| Equivalent Series Resistance (ESR) | 50 | Ω Max | 1 |
| Shunt Capacitance (C ₀) | 7 | pF Max | 1 |
| Load Capacitance (C _L) | 8 | pF Max | 1 |
| Drive Level | 0.3 | mW Max | 1 |
| Aging per year | ±5 | PPM Max | 1 |

Notes:

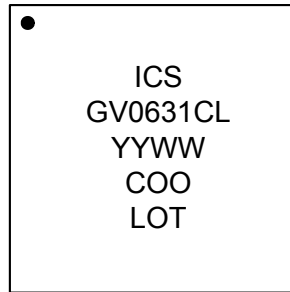
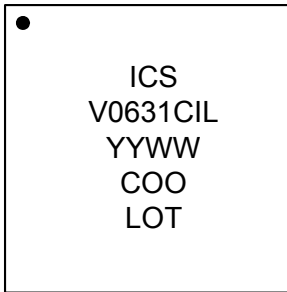
1. FOX 603-25-150.
2. For I-temp, FOX 603-25-261.

Thermal Characteristics

| PARAMETER | SYMBOL | CONDITIONS | PKG | TYP. | UNITS | NOTES |
|--------------------|----------------|---------------------------------|-------|------|-------|-------|
| Thermal Resistance | θ_{JC} | Junction to Case | NDG40 | 42 | °C/W | 1 |
| | θ_{Jb} | Junction to Base | | 2.4 | °C/W | 1 |
| | θ_{JA0} | Junction to Air, still air | | 39 | °C/W | 1 |
| | θ_{JA1} | Junction to Air, 1 m/s air flow | | 33 | °C/W | 1 |
| | θ_{JA3} | Junction to Air, 3 m/s air flow | | 28 | °C/W | 1 |
| | θ_{JA5} | Junction to Air, 5 m/s air flow | | 27 | °C/W | 1 |

¹ePad soldered to board

Marking Diagrams



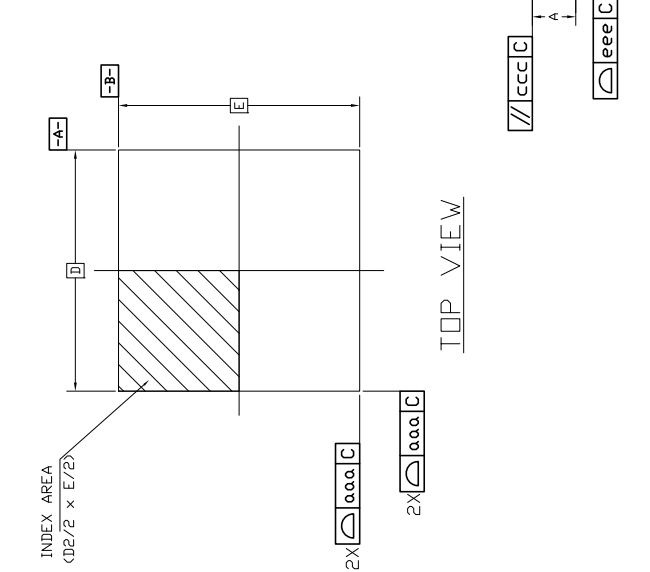
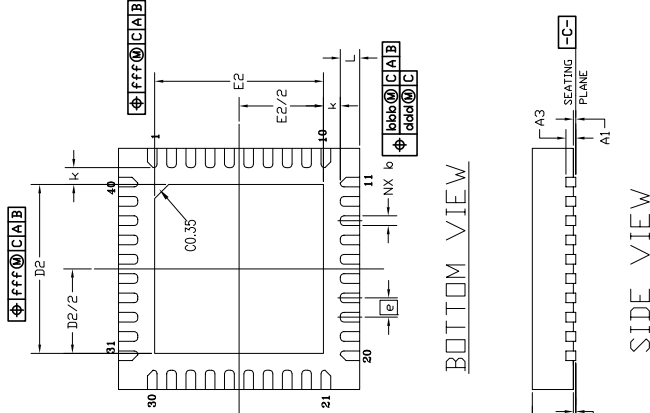
Notes:

1. Line 2: truncated part number.
2. "I" denotes industrial temperature.
3. "L" denotes RoHS compliant package.
4. "YYWW" is the last two digits of the year and week that the part was assembled.
5. "COO" denotes country of origin.
6. "LOT" is the lot number.

Package Outline and Dimensions (5 x 5 mm 40-VFQFPN)

| REVISIONS | | | |
|-----------|-----------------|---------|----------|
| REV | DESCRIPTION | DATE | APPROVED |
| 00 | INITIAL RELEASE | 5/17/16 | JH |

| SYMBOL | DIMENSION | | |
|--------|-------------|------|------|
| | MIN | NOM | MAX |
| b | 0.15 | 0.20 | 0.25 |
| D | 5.00 BSC | | |
| E | 5.00 BSC | | |
| D2 | 3.40 | 3.50 | 3.60 |
| E2 | 3.40 | 3.50 | 3.60 |
| L | 0.30 | 0.40 | 0.50 |
| e | 0.40 BSC | | |
| N | 40 | | |
| ND | 10 (note 3) | | |
| NE | 10 (note 3) | | |
| A | 0.80 | 0.90 | 1.00 |
| A1 | 0.00 | 0.02 | 0.05 |
| A3 | 0.2 REF | | |
| k | 0.35 REF | | |
| aaa | 0.10 | | |
| bbb | 0.07 | | |
| ccc | 0.10 | | |
| ddd | 0.05 | | |
| eee | 0.08 | | |
| fff | 0.10 | | |



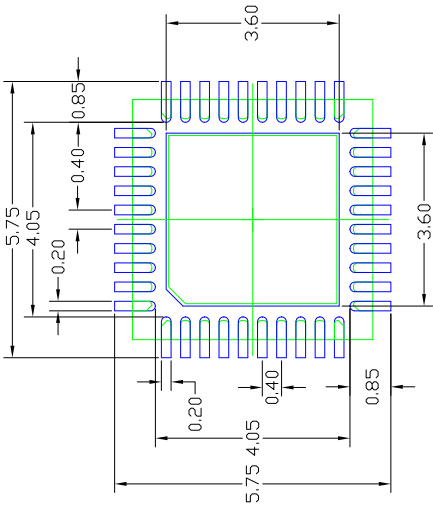
| | | | |
|---|--|--|--|
| <p>6024 SILVER CREEK VALLEY ROAD, SAN JOSE, CA 95138 PHONE: (408) 284-8200 FAX: (408) 284-3572</p> <p>IDT™ www.IDT.com</p> | | <p>UNLESS SPECIFIED DECIMAL ANGULAR ±1°</p> <p>XX.X .05 XX.XE .030</p> | |
| <p>TITLE/NDG40 PACKAGE OUTLINE 5.0 x 5.0 mm BODY,EPAD 3.50mm SQ. 0.40 mm PITCH QFN</p> | | <p>DATE 05/31/10</p> | |
| <p>SIZE DRAWING No. C PSC-4292-02</p> | | <p>APPROVALS DRAWN 7702 CHECKED</p> | |
| <p>DO NOT SCALE DRAWING</p> | | <p>REV 00</p> | |
| <p>SHEET 1 OF 2</p> | | <p>REV 00</p> | |

NOTES:

1. ALL DIMENSIONING AND TOLERANCING CONFORM TO ANSI Y14.5M-1982
2. ALL DIMENSIONS ARE IN MILLIMETERS.
3. ND AND NE REFER TO THE NUMBER OF TERMINALS ON EACH D AND E SIDE RESPECTIVELY.

Package Outline and Dimensions (5 x 5 mm 40-VFQFPN), cont.

| REVISIONS | | | |
|-----------|-----------------|---------|----------|
| REV | DESCRIPTION | DATE | APPROVED |
| 00 | INITIAL RELEASE | 5/17/16 | JH |



RECOMMENDED LAND PATTERN

NOTES:

1. ALL DIMENSIONS ARE IN mm. ANGLES IN DEGREES.
2. TOP DOWN VIEW AS VIEWED ON PCB.
3. COMPONENT OUTLINE SHOWS FOR REFERENCE IN GREEN.
4. LAND PATTERN IN BLUE. NSMD PATTERN ASSUMED.
5. LAND PATTERN RECOMMENDATION PER IPC-7351B GENERIC REQUIREMENT FOR SURFACE MOUNT DESIGN AND LAND PATTERN.

| | | | |
|---|----------|---|--------------|
| TOLERANCES UNLESS SPECIFIED DECIMAL XX±.05 ANGULAR XXX±.030 ±1° | | IDT™ 6024 SILVER CREEK VALLEY ROAD, SAN JOSE, CA 95138 PHONE: (408) 284-8200 FAX: (408) 284-3572 www.IDT.com | |
| APPROVALS | DATE | TITLE/NDG40 PACKAGE OUTLINE | REV |
| DRAWN <i>mtw</i> | 05/31/10 | 5.0 x 5.0 mm BODY, EPAD 3.50mm SQ, 0.40 mm PITCH QFN | 00 |
| CHECKED | | SIZE DRAWING No. | C |
| | | PSC-4292-02 | 00 |
| | | DO NOT SCALE DRAWING | SHEET 2 OF 2 |

Ordering Information

| Part / Order Number | Shipping Packaging | Package | Temperature |
|---------------------|--------------------|---------------|---------------|
| 9FGV0631CKLF | Trays | 40-pin VFQFPN | 0 to +70° C |
| 9FGV0631CKLFT | Tape and Reel | 40-pin VFQFPN | 0 to +70° C |
| 9FGV0631CKILF | Trays | 40-pin VFQFPN | -40 to +85° C |
| 9FGV0631CKILFT | Tape and Reel | 40-pin VFQFPN | -40 to +85° C |

“LF” suffix to the part number are the Pb-Free configuration and are RoHS compliant.

“C” is the device revision designator (will not correlate with the datasheet revision).

Revision History

| Rev. | Initiator | Issue Date | Description | Page # |
|------|-----------|------------|--|---------|
| A | RDW | 9/29/2014 | 1. Updated front page text and block diagram. 2. Updated pin out to remove references to VDD Suspend pins. Using the part with collapsible power supplies did not save power and complicated board design. NO pins were changed. 3. Updated SMBus Descriptions 4. Simplified footnote 2 on PPM table. 5. Updated all electrical tables 6. Move to final | Various |
| B | RDW | 10/18/2016 | Removed IDT crystal part number | |
| C | RG | 6/23/2017 | Updated front page Genes to reflect the PCIe Gen4 updates. Updated Electrical Characteristics - Filtered Phase Jitter Parameters - PCIe Common Clocked (CC) Architectures and added PCIe Gen4 Data | 1,7 |



Corporate Headquarters
6024 Silver Creek Valley Road
San Jose, CA 95138 USA
www.IDT.com

Sales
1-800-345-7015 or 408-284-8200
Fax: 408-284-2775
www.IDT.com/go/sales

Tech Support
www.IDT.com/go/support

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